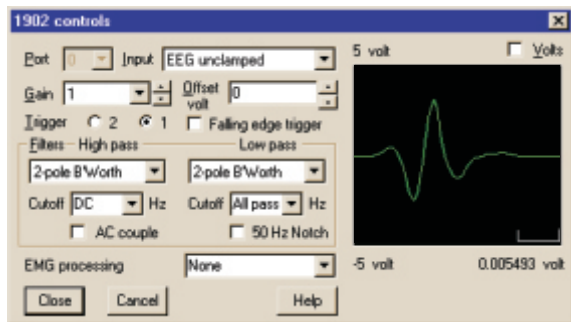


The CED 1902

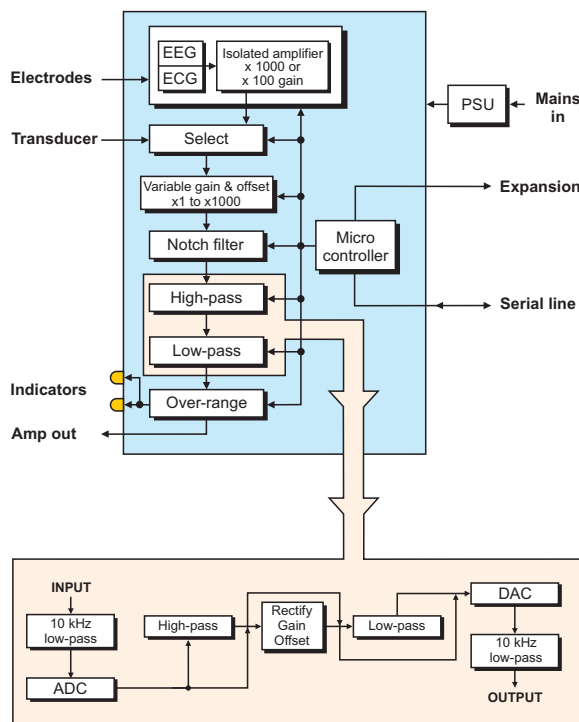
isolated pre-amplifier and accessories

For EMG, EEG, ECG, ERG, Evoked Response, Skin Conductance, Tremor measurement, Auditory Brainstem and many more life science and engineering research applications



1902 control panel

Waveform signal flow in 1902



1902 digital filtering sub-system



SYSTEM INTRODUCTION

The 1902 signal conditioner is a versatile modular unit designed to work with modern computer-controlled data acquisition systems. Developed for a broad range of applications, the 1902 accepts biological and instrumentation signals from a wide variety of sources.

It is available in single or multi channel configurations. Communication with the computer is achieved through a serial line, allowing multiple sets of units to be controlled simultaneously.

Software controllable features

- Programmable gain with readback
- Selectable high and low pass filter settings
- Dynamically controlled 12-bit offset
- Selectable mains notch filter
- AC/DC coupling
- Optional input clamping

A major advantage of programmable amplifiers is the degree of interaction between the signal conditioner and the application software recording the data. The 1902 is directly controlled through the CED data acquisition and analysis programs Spike2 and Signal, or through a stand-alone control application.

The isolated electrode input

The 1902 is designed to a specification worked out in conjunction with major UK physiological laboratories for an isolated amplifier to comply with EN 60601-1. It provides a low noise differential electrode input developed specifically for EEG, EMG, ECG and evoked potential applications.

IMPORTANT NOTE: The CED 1902 is sold as a research instrument and not as a medical device within the meaning of the EC Medical Device Directive.

The transducer input port (non-isolated)

The transducer input port is suitable for use with a wide range of bridge and other transducers. It will accept single-ended and differential inputs and provides 5 volt and 12 volt outputs to supply the excitation voltages required by many transducers. Applications include: isometric force, strain gauges, temperature, pressure, acceleration, displacement and goniometers.

The 1902 is available in a transducer-only form with no isolated electrode input.

Standard features

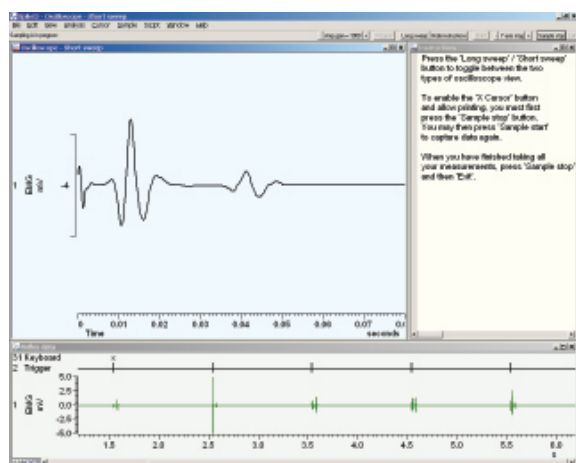
- Digital filters generated according to user-entered filter cut off values
- Trigger input converter from high-level pulses or switch closures to 5V TTL
- Overload indicators with software readback
- EMG filter with full wave rectifier and programmable post-filter gain
- 16-bit ADC for digitisation of transducer and other low-bandwidth signals and transmission of results down the serial line



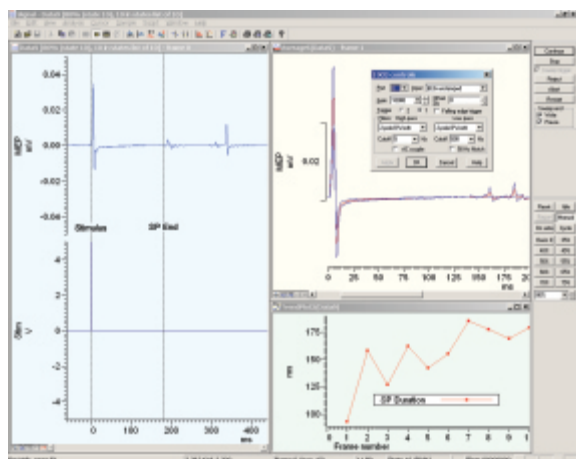
Multiple 1902s



19" rack-mount multiple 1902s



Reflex recording with Spike2 in teaching application including script controlled 1902 gain settings.



Capture and analysis of EMG triggered around TMS

Specialist 1902 options

- Stimulus artefact clamp to avoid saturation of the amplifier when using high intensity magnetic or other stimuli
- Buffer option: maintains common-mode rejection when a single reference electrode needs to feed multiple channel inputs
- ECG front end with 5 lead switching under software control. Lead configurations available: I, II, III, aVL, aVR, aVF and V. Calibrator: 1 mV rectangle wave. Gain is selectable from x100 to x100,000
- CED 2502 skin conductance expansion module takes direct measurements of conductance (GSR) using the constant DC potential method

Applications

1902s are suitable for direct connection to the subject to record a variety of biological signals including EEG, EMG and ECG. With an additional module, they can also be configured to measure skin conductance. The non-isolated transducer input allows connection to many types of transducers for capture of other data such as force, temperature, acceleration, strain and displacement.

Both Spike2 and Signal software packages include built-in control for the 1902. Each package interacts with the 1902s to automatically adjust scaling and add markers to annotate changes in amplifier settings where appropriate. Amplifier settings are stored in Spike2 and Signal sampling configurations, therefore when switching between experiments, amplifier settings are restored automatically.

CED 1902 and Spike2

Spike2 records event and waveform data into a file with a continuous time base, making it ideal for applications including sleep studies, biomechanics, behavioural experiments and cardiovascular research. Changes to the 1902 gain and other software controlled settings are recorded as text notes alongside the conditioned waveforms.

With the aid of *active cursors*, you can take measurements automatically while recording the amplified and filtered signals. Features from waveforms such as ECG and blood pressure can be detected, and their times, values and other measurement results plotted to an XY view for display and export in spreadsheet format. Results can also be saved inside the data document as additional channels, marking where the measurement was taken and the result.

CED 1902 and Signal

Signal, being a frame-based recording system, is more suited to applications such as evoked response (visual, auditory, electrical, TMS). It is also ideal for biomechanical applications, for example in conjunction with force plates. For TMS and electrical stimulation experiments, the 1902 optional input clamp is designed to suppress artefacts which would otherwise saturate the amplifier if the recording site is close to the stimulation point.

CED software customization

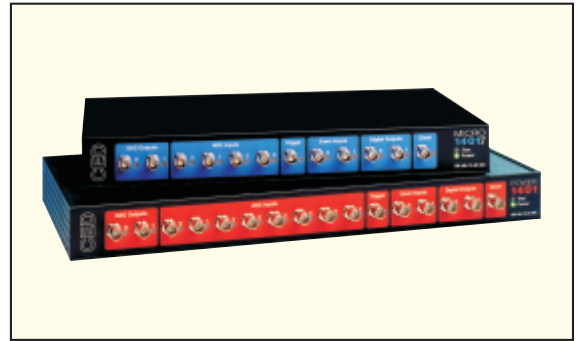
Both the Spike2 and Signal packages include a script language, allowing the user to customize the system for specific requirements. Scripts can be used to control almost every aspect of the software, including the 1902s. Users can therefore create their own 1902 controls through dialogs and toolbars, integrated with other parameters for specific experiments.

CED 1902 associated products

The CED 1401 range of laboratory interfaces

Both the CED Power1401 and Micro1401 interfaces provide multi-channel high speed waveform and digital data recording with simultaneous waveform and digital output for real-time multi-tasking data acquisition, stimulus generation and experiment control. Fitted with on-board processors and high-speed memory, these powerful units allow complex on-line analysis and fast automated responses, freeing time for the host computer to perform other tasks.

These modular units are expandable to address user specific requirements. They each run both Spike2 and Signal software packages, with the Micro1401 being more than capable of handling the majority of data acquisition requirements and the Power1401 ideal for more demanding applications.



The CED 1902-11 electrode adaptor boxes

The CED 1902-11 passive electrode adaptor boxes are available in three forms, 2-channel, 4-channel and 16-channel. Fitted with either 1.5mm or 2mm safety connectors, they offer the convenience of direct connection to the isolated input of the 1902.



The CED 1902-10 headstage

The CED 1902-10 battery-powered headstages, available in 2-channel and 4-channel versions, are designed to adapt isolated amplifiers like the CED 1902 to work with resistively unbalanced sources such as needle electrodes. The 1902-10 presents a low-capacitance differential input to the source and generates a buffered low-impedance differential output to drive the isolated amplifier. There is a switchable gain of x1, x3 or x10, common to all channels.



The CED 2502 and CED 2502-SA

The 2502 skin conductance unit is designed to take direct measurements of the conductivity between two electrodes. Conductance values up to $100\mu\text{mho}$ ($100\mu\text{Siemens}$) can be measured in three ranges. The output from the CED 2502 is designed to feed the isolated electrode input of a CED 1902 amplifier. The CED 2502-SA version produces an isolated single-ended high-level signal designed to drive a CED 1401 Laboratory Interface or other data acquisition equipment.



The CED 2804 External Clamp Box

This four-channel device can be used with any amplifier to prevent input saturation, as for instance when high voltages or intense magnetic fields are used as stimuli. On receipt of a TTL signal from external trigger equipment it clamps incoming electrode signals for the duration of the trigger signal. It can operate in several different clamping modes, as selected by a rear-panel switch.



The CED 3304 Current Stimulator

The CED 3304 is an isolated current stimulator that can generate a pulse of current between two outputs for the length of an active input trigger. It is programmed and controlled by a serial interface, either an RS232 connection or a USB virtual serial port. One of four current magnitude ranges ($10\mu\text{A}$, $100\mu\text{A}$, 1mA , or 10mA full-scale) can be selected by a rotary switch on the front panel. The magnitude within the range is set via software. Warning indicators show if a pulse was under-current or over-charge. The status of the battery, isolated section, serial inputs and trigger input can also be monitored.



CED 1902 technical specifications

Main amplifier		Isolation pre-amplifier		
Bandwidth	DC to 10 kHz (-3dB) in DC mode 0.16 Hz to 10 kHz in AC mode	Front end type	Low noise EEG	ECG
Gain accuracy	±2%	Input impedance	10 GOhm	
Filter response	Bessel or Butterworth	Input bias current at 25°C	±150 pA	
Filter slope (low- and high-pass)	2 nd or 3 rd order (12 or 18 dB/octave)	Noise referred to input, 1 Hz - 10 kHz	0.3 µV rms.	
Low-pass filter corner frequency	1 Hz - 10 kHz cont. variable	Common-mode rejection at 50 Hz	100 dB	
High-pass filter corner frequency	0.01 Hz - 1 kHz cont. variable	Common-mode voltage range	±1 V	
Filter latency	0.35 ms (approx.)	Input offset voltage, initial adjusted	less than 10 µV after 1-hour warmup	
Rectification	User-selectable	Input offset voltage vs. temperature	5.5 µV/°C	
Mains notch cut (50 Hz or 60 Hz)	50 dB (typical)	Input offset voltage vs. time	1.5 µV / 1000 hrs	
Overload indicator	2 yellow LEDs (1 for each polarity) indicate when input is overrange	Gain ranges (Including 1902 system board)	1,000 - 1,000,000	100 - 100,000
Control		Gain step sequence	1, 3, 10...	
		Gain accuracy	±2%	
RS232 serial line 9600 Baud USB via optional USB-serial adaptor		Bandwidth, all gains	DC - 10 kHz (-3 dB)	
		Isolation voltage, continuous	1500 V DC	
		Isolation voltage, peak for 5 sec	2500 V peak	
		Input-output leakage at 240V, 50 Hz	less than 20 µA	
IMPORTANT NOTE: The CED 1902 is sold as a research instrument and not as a medical device within the meaning of the EC Medical Device Directive.		Input clamp option	0.5 ms - 14 ms	—
		Lead configurations	—	I, II, III, aVR, aVL, aVF and V
		Calibrator	—	1mV pulse

Transducer input		Trigger inputs	
Input impedance	1 GΩ	Input impedance	100 kΩ
Input bias current at 25°C	50 nA	Voltage range	±15V
Common mode rejection (at x100 gain)	80 dB at 50 Hz	Trigger polarity	Selectable
Bandwidth	DC - 10 kHz	Trigger level	+1.25V (approx.)
Gains	x1 to 100,000	Trigger hysteresis	+0.5V (approx.)
Gain step sequence	1, 3, 10	Output pulse	TTL negative-going
Gain accuracy	±2%	Output pulse length	3 µs
Noise 1 Hz to 10 kHz (at x100 gain)	1 µV r.m.s	Trigger output drive capability	0.9 mA maximum

Power supplies & dimensions (single channel 1902)	
1902 chassis mechanical dimensions	Width 240 x height 46 x depth 240 mm
1902 unit weight (approx.)	2.5 Kg
Power input	100-240V AC external power supply (PSU can supply up to four 1902s)
PSU weight	750g



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